PILOT PROJECT TO EVALUATE
ORTHENE® FOR CONTROLLING
THE WESTERN SPRUCE BUDWORM

1977

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FOREST INSECT AND DISEASE CONTROL
STATE AND PRIVATE FORESTRY
U. S. FOREST SERVICE
OGDEN, UTAH

ENTOMOLOGICAL PLAN

PILOT PROJECT TO EVALUATE ORTHENE ®
FOR CONTROLLING THE WESTERN SPRUCE BUDWORM

by

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U.S. Department of Agriculture
Forest Service, Region 4
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INTRODUCTION

The Forest Service, Region 4, in cooperation with the State of Idaho and the Boise Cascade Corporation, plans to aerially spray approximately 4,000 acres of Federal, State, and private lands in the vicinity of McCall, Idaho in late June and early July of 1977. The purpose of this project will be to determine the effectiveness of a single application of Orthene® at a rate of ½ pound in one gallon of water per acre for population reduction of the western spruce budworm, Choristoneura occidentalis Freeman. This is part of a Forest Service commitment to have several insecticides available for controlling the western spruce budworm.

This plan describes the project area, design, sampling procedures, project organization, and budget. For comparability of data between this and other projects conducted in the past by other Regions, the project design and sampling procedures are similar to those of recent projects. Minor variations recommended by the Methods Application Group (MAG) in Davis, California, have been made for this particular project, but all project results will be presented in a common format.

OBJECTIVES

The objectives of this project are:

(1) To compare the operational efficacy of Orthene® against the western spruce budworm with research results from past Orthene® field tests;

(2) To identify any operational problems associated with the mixing and application of Orthene® when used under operational conditions;

(3) To determine the unit cost for operational use of Orthene® at ½ lb. per acre for western spruce budworm suppression.

PROJECT AREA

This project will be located in western spruce budworm infested Douglas-fir and grand fir stands on portions of the Payette National Forest and adjacent Bureau of Land Management, State of Idaho, and Boise Cascade lands. Data collected from an expanded egg mass survey conducted during 1976 on the Payette National Forest indicate moderate to heavy defoliation to continue during 1977. Spray blocks will be selected in areas where heavy defoliation has been predicted for 1977. The actual spray boundaries will be adjusted using information from a field check of larval density in late May 1977.

The overall project area extends from Bally Mountain, New Meadows Ranger District, on the north to Sloans Point, McCall Ranger District, on the south. This area consists primarily of mixed conifer stands. Forest activities on this land, include, but are not limited to, timber harvesting, grazing allotments, summer home sites, summer and winter recreation sites, small and big game hunting, mining and watersheds.

INSECTICIDE

Orthene® 1/ is a broad spectrum organophosphate insecticide which penetrates plant tissues thereby increasing residual activity. Orthene® has shown excellent control of several forest defoliators and numerous agricultural insect pests. Previous tests against both the eastern and western spruce budworm indicate that a satisfactory degree of population reduction (95%+) and a minimum of adverse effects against mammals, birds, fish, and other nontarget organisms will occur.

PROJECT DESIGN

This project will entail one aerial application of Orthene® against late instar larvae on four replicated blocks of 1,000 acres each. Four other 1,000 acre blocks will serve as checks and will not be treated.

Block Selection

Each treatment and check block will be selected on the basis of (1) budworm population density, (2) host type, (3) topography and (4) access. Where possible, block boundaries will follow prominent topographic features for ease of identification and location. Breaks in type or clearings will also be used as boundaries.

Sample Clusters

Cluster plots of three trees each will be established within each block and used as the basic sampling unit. Twenty-five three tree clusters will be selected in each block. Budworm population density will be based on the mean number of larvae per 100 buds. These clusters will be carefully selected and distributed throughout each block in order to best represent each block, and will be located at least 2 chains from the block boundary and/or roads.

1/ 10, S-Dimethyl acetylphosphoramidothioate.

Sample Trees

Trees selected for sample cluster trees will be open grown Douglas-fir or grand fir 35-60 feet tall with full crowns. Previous defoliation should be less than 25 percent. Host tree species will not be mixed in an individual cluster. All trees in a cluster will be located within a one-acre area (radius of 118 feet).

Sampling Periods

Sampling of various life stages will be made at four different times during the project to:

1. Measure rate of larval development by instar in order to calculate percent in each stadium.

2. Determine prespray larval population density in each block.

3. Measure postspray population density three days after spraying.

4. Measure postspray population density 10 days following treatment.

The sampling techniques for each period are described below:

1. Development Sampling. An accurate determination of larval development is essential for the proper timing of the insecticide application. Ten single tree plots which will be independent of the cluster plots will be established well in advance of the projected treatment date. These plots will be distributed throughout the elevational range within each block. Two 45 cm branches will be cut from opposite sides of the mid-crown of each tree and placed individually in paper bags. Development sampling will begin when the vegetative buds begin to break. Sampling frequency will increase to daily when the number of 4th instar larvae approaches 50 percent.

2. Prespray Sampling. The prespray population sample will be taken when it is determined by the development sample that 50 percent of the larvae are in the 5th instar. Two 45 cm branches will be removed from the north and east quadrants at midcrown from each of the 75 cluster trees. Extreme care must be exercised in order to avoid knocking larvae off the sample branch as it is being cut. Careless knocking of branches will result in an under estimate of the population.

   Each branch and all contents of the catch bag will be placed in separate paper bags. All the bags from each cluster will be fastened together and transported to the laboratory. During handling and transfer, care will be taken to keep samples cool and out of direct sunlight.

3. Postspray Sampling. Postspray samples will be taken from the same cluster trees used for the prespray sample. Two postspray samples will be collected; one at 3 days and the other at 10 days following treatment. Prespray sampling procedures will be used except four branches will be cut; one from each quadrant of the tree (north, south, east, west). Again, care should be taken not to dislodge larvae from sample branches or other branches on the tree. Individually bagged samples will be taken to the laboratory for larval counting.

Laboratory Procedures. The basic function of the field laboratory will be to count and tabulate all larval data from branches collected during the different sampling periods. Branch samples delivered to the laboratory will be placed in cold storage ($4^{o}C$). Samples arriving each day will be processed by the end of the next day. Specific procedures will be described as follows for each sampling period:

1. Development. Each branch will be thoroughly examined for budworm larvae. All larvae will be collected and placed in 70 percent ethyl alcohol. Larvae will be separated by instar on the basis of physical characteristics by a trained technician. Blocks will be released for treatment when the 10 plot mean shows that 50 percent are 5th instar.

2. Prespray. Data required from the prespray samples are area of foliage (m^2), number of vegetative buds (shoots), number of budworm larvae, and number of other defoliating larvae. Population data will be expressed in terms of the number of budworm per 100 buds.

3. Postspray. Laboratory procedures will be the same as for those described under prespray.

DATA ANALYSIS

Pesticide effectiveness will be determined by a comparison of postspray larval population densities between treated and untreated blocks. Postspray population means will be adjusted to minimize effects due to variation among prespray larval densities. Check block samples will be taken during the same stage in larval development to provide comparability among the prespray larval populations.

The effectiveness of the Pilot Project will be determined by the number of live larvae per 100 buds. A reduction in the budworm population to three or fewer larvae per 100 buds will be considered an effective treatment.

Estimates for larval population density by cluster will be computed for each sampling period and expressed as the number of larvae per 100 buds. The analysis will be made by a fixed effect model with random subsampling within each block. The design is a completely randomized experiment with the 8 blocks (4 Orthene® and 4 checks) assigned at random.

Analysis of Variance Model:

$$Vijk = M + ti + lij + Nijk$$

where Nijk is the sampling error due to subsampling within each block
lij is the experimental error between blocks
Ti is the effect due to treatments
Yijk is the observation (budworm/100 buds in the kth tree from the jth replication in the ith treatment)
i = 1, 2 treatment (Orthene® and check)
j = 1, 2, 3, 4 replicates
k = 1, ..., 25 clusters within each block.

The analysis of spray deposit data will be made to determine the relationship between spray coverage and budworm mortality. A standard linear regression analysis will be used to compute regression and correlation coefficients.

TIMING AND APPLICATION

The release of each block for treatment will be made when 50 percent of the larvae are in the 5th instar. At the time a block is released, the prespray sample will be taken. If a block is not sprayed within 48 hours of the prespray sample, another prespray sample will be needed prior to treatment.

The spray mixture will be applied by a helicopter of the type generally used for defoliator control in a forested enviornment. Spray aircraft will require calibration to insure the desired application rate of ½ pound Orthene® per acre is obtained. Calibration will include the spraying of a small amount of insecticide over an open area. To minimize variation in the application, only one day will be allowed to spray any given block.

A one-swath width strip will be left on each side of major streams and waterways. Major streams and waterways are defined as perennial streams, or segments thereof, that are a direct source of water for domestic use and/or are used by significant numbers of fish for spawning, rearing, or migration, and flow enough water to have a major influence on downstream water quality.

All streams, waterways, and other critical areas to be protected will be designated by the Forest Service, the State of Idaho, and the Boise

Cascade Corporation. After these have been identified they will be marked on all Unit maps or photos and on all maps and photos used by the aerial observers. Other critical areas will be marked and left untreated in the same manner. Spraying will not be done parallel to slow, shallow, meandering streams or directly over lakes or ponds.

Spray observers will insure that the one-swath width untreated strip along major streams, waterways, and other critical areas is maintained.

As part of the helicopter contract, the contractor will furnish the equipment necessary for mixing and handling the spray mixture. The contractor will provide a 500 gallon mixing tank with mechanical agitation and a metered pump to measure loading. All insecticide mixture for one days operation can be prepared with equipment of this type.

PESTICIDE STORAGE AND DISPOSAL

Pesticides will be stored near the project headquarters per the guidelines found in FSM 8545.3. These guides include the following:

1. Store in a locked dry storage shed where those not authorized cannot come in contact with them.

2. Plainly label each entrance to the pesticide storage area with prominent waterproof sighs bearing the words "Pestcide Storage."

3. Store pesticide in the original, labeled container, making sure each label is both visible and legible.

4. Store "empty" pesticide container as though they were full until proper disposal can be arranged.

5. Never store pesticides near food or animal feeds.

The local fire department will be notified of the storage area, its contents, and any special hazards should there be a fire.

Disposal of unused pesticides and pesticide containers will follow the procedures and guidelines found in FSM 8545.4 and a memo to all Forest Supervisors dated June 24, 1975, 1310 Planning (3000).

METEROLOGY

Local weather forecasts and weather observations during the application will be provided by a meteorologist from N.O.A.A. Forecasts on local weather will be presented to the Project Director each evening.

A weather observer will be stationed in the spray block during the application to monitor wind speed, relative humidity, and temperature. Spraying will not continue when either the temperature exceeds 18°C or wind speeds are over 6 mph. Rain guages will be placed in each unit 10 days before the projected spray date to measure precipitation prior to spraying.

MONITORING

The major portion of the monitoring planned for this project will be conducted by the Pacific Southwest Experiment Station in cooperation with other reseachers. Independent work plans will be prepared to describe the sampling techniques to be used for pre- and post-spray population estimates of ants, wild pollinators and birds. Project field crews will monitor nontarget insect populations on host trees. Drop cloths will be placed around two cluster trees in each block to identify the short term effect of Orthene ^{R} on nontarget insects.

SPRAY DEPOSIT ASSESSMENT

Spray deposit assessment will be evaluated on the amount of spray material deposited on Krome-Kote cards placed in the spray block. The cards will be placed in holders the morning of spraying. Six deposit cards will be located at each cluster in the block. A marking agent, Rhodamine B extra S dye, will be added to the water base spray at the rate of 1.25 grams per liter.

1. At Cluster Trees. Four spray deposit cards will be put in card holders and placed on the ground at the drip line of a single tree in each cluster. These cards will be placed at the four cardinal directions of the selected tree (100 cards per block).

2. In Open Areas. Two additional cards will be placed in openings near each cluster (50 cards per block).

Cards will be analyzed to determine the number of drops per CM^2 and pounds of insecticide per acre. This analysis will be supervised by personnel from the Methods Application Group, Davis, California.

Spray deposit sampling in two of the four blocks may be modified to test the operational use of a new deposit assessment technique. This new system will be tested in cooperation with the Douglas-fir Tussock Moth Research Program. The new system is essentially the same as used with the standard dye technique except ferric chloride is used in place of Rhodamine dye. The number of spray deposit cards placed in the

remaining two blocks will be increased from 4 per cluster (4 at one cluster tree) to 4 at all 3 cluster trees (300 cards per block). Rhodamine dye will be used on one of these blocks and ferric chloride on the other. Any additional costs incurred as a result of the expanded sampling will be absorbed by the Tussock Moth Project. A complete sampling plan prepared by the Tussock Moth Research Team describing this modification will be appended to this plan.

DEFOLIATION ASSESSMENT

Defoliation estimates will be made for one tree of each cluster in both treatment and check areas. The procedure for measuring defoliation will include removing 25 shoots from each sample branch and individually examining each shoot for defoliation. The pre- and post-spray samples will include a two and four branch sample respectively.

Each new shoot will be individually classified as follows:

Percent Defoliation	Rating
0 - 25	1
26 - 50	2
51 - 75	3
76 - 100	4

To measure current years' foliage saved a covariance analysis will be used to test significant differences of slope and intercept between untreated and treated clusters where the independent variable is the pre-spray population and the dependent variable is the percent defoliation in arcsine transformation format.

To measure foliage saved 1 year after treatment, an analysis of variance in a completely randomized block design will be used to compare differences of defoliation between check and treated plots if such differences occur. Another possibility is to use a multiple covariance analysis to detect differenced in defoliation.

The budworm population will be remeasured in each plot at a time corresponding with the pre-spray sample the year following treatment (1977), to determine if larval populations remain low in treatment plots compared to checks.

POST TREATMENT YEAR EVALUATION

Although not funded at this time, a post treatment (1978) evaluation is proposed to evaluate the long range effects of this treatment. This

evaluation would include sampling to determine the population densities during the same sampling periods when spraying was conducted. The same techniques would be used on the same cluster trees that were sampled during the project. Egg mass densities and defoliation data would also be collected in both the treatment and check blocks.

ORGANIZATION

Personnel from the Insect and Disease Control Staff, State and Private Forestry, Region 4, in cooperation with the Payette National Forest and the State of Idaho, will administer this project.

Coordination and supervision of the project will be through the Director of Insect and Disease Management assisted by other Regional Office Staff Groups and the appropriate National Forests.

The State of Idaho, Department of Lands, has the responsibility of providing a Project Director and a 11-person field crew. The work involved will be conducted according to the Project Entomological Plan and at the direction of the U.S. Forest Service, R-4, Forest Insect and Disease Control, Ogden, Utah.

The Payette National Forest has responsibility to provide an Administrative Officer, a Safety Officer, a Heliport Manager, clerical services, and an 11-person laboratory crew.

The Insect and Disease Control Staff will provide a Project Entomologist, an Air Operations Officer, and a Laboratory Technician.

All personnel expenses for the Forest, the State of Idaho, certain expenses for the Project Director, and all travel expenses for the I&DC Staff will be reimbursed with project funds.

The basic project organization is illustrated in Figure 1. The responsibilities and duties of each position are described below:

1. Project Director (State of Idaho). Overall responsibility for the entire conduct of the project including the coordination of all key project personnel. Will also provide contact with all outside agencies.

2. Administrative Assistant (Payette National Forest). Will report directly to the Project Director and be responsible for timekeeping, contract administration, purchasing, recordkeeping, and clerical chores.

3. Inform and Involve Officer (Boise National Forest). Will prepare and distribute timely news releases through the appropriate

media. Will also serve as spokesman to the public and attend and/or conduct any public meetings required.

4. Safety Officer (Payette National Forest). Will insure that all phases of the project are conducted in the safest manner possible. Will review all safety plans for sound principles and make recommendations for the correction of any unsafe practices or conditions.

5. Project Entomologist (Insect and Disease Control). Will be responsible for the entomological phase of the project. specific duties will include training field and laboratory personnel, maintain proper records, maintain data summaries on insect development and population and release blocks for treatment. Will also prepare a final report within 90 days following final data analysis.

6. Meteorologist. Will be responsible for all forecasts and weather monitoring during the project.

7. Air Operations Officer (Insect and Disease Control). Will be responsible for developing and execution of the air operations work plan, coordination of air safety, and act as aerial observer. Will also maintain detailed data on each spray mission--aircraft, gallonage, area sprayed, etc.

8. Spray Pilot (Contract). Will brief the Project Director on proposed spray swath distribution prior to spraying each block. Will make final decisions regarding the proper and safe use of the spray aircraft.

9. Loader. Will assist the Heliport Manager and will be responsible for loading and keeping load records by helicopter load and spray block.

PROPOSED PROJECT BUDGET

Aircraft		
Spray aircraft	21,000.00	
Observation aircraft	5,000.00	26,000.00
Pesticide		
Orthene®	7,700.00	
Dye	400.00	8,100.00
Rental Equipment and Supplies		
Vehicles (8)	8,500.00	
Gasoline and oil	2,500.00	11,000.00
Equipment		
Field and laboratory	10,600.00	10,600.00
Personnel (salaries)		
Payette National Forest		
Administrative Assistant	1,000.00	
Safety Officer	600.00	
Heliport Manager	400.00	
Clerk	800.00	
Laboratory Crew (11)	4,500.00	
Forest overhead for above	400.00	7,700.00
Boise National Forest		
I&I Officer	500.00	500.00
State of Idaho		
Field crew (11)	14,110.00	
Travel and per diem for Director	1,000.00	
Fringe Benefits	2,490.00	17,600.00
Insect and Disease Control		
Project Entomologist	6,200.00	
Air Operations Officer	4,800.00	
Laboratory Assistant	1,440.00	
Ogden Zone Leader	1,600.00	
Boise Zone Leader	1,600.00	*15,600.00
Administration		
Overtime	2,500.00	
Travel and per diem		
Planning phase	2,500.00	
Field phase	4,500.00	9,500.00
Services		
Spray deposit card analysis	1,300.00	
Meteorologist	1,000.00	
Telephone	200.00	
Data analysis	400.00	
Office and laboratory rental	300.00	
Maps and aerial photographs	300.00	3,500.00
		110,100.00
Regional Office overhead		5,500.00
	Grand Total	115,600.00

*Contributed Salaries

REPORTING

The Pilot Project Report will be available in the WO-FI&DM on December 1, 1977. This will cover the following items:

1. A comparison of actual and expected results.

2. An appraisal of the results, including the advantages and disadvantages of operational application of the material.

3. A list of recommended modifications.

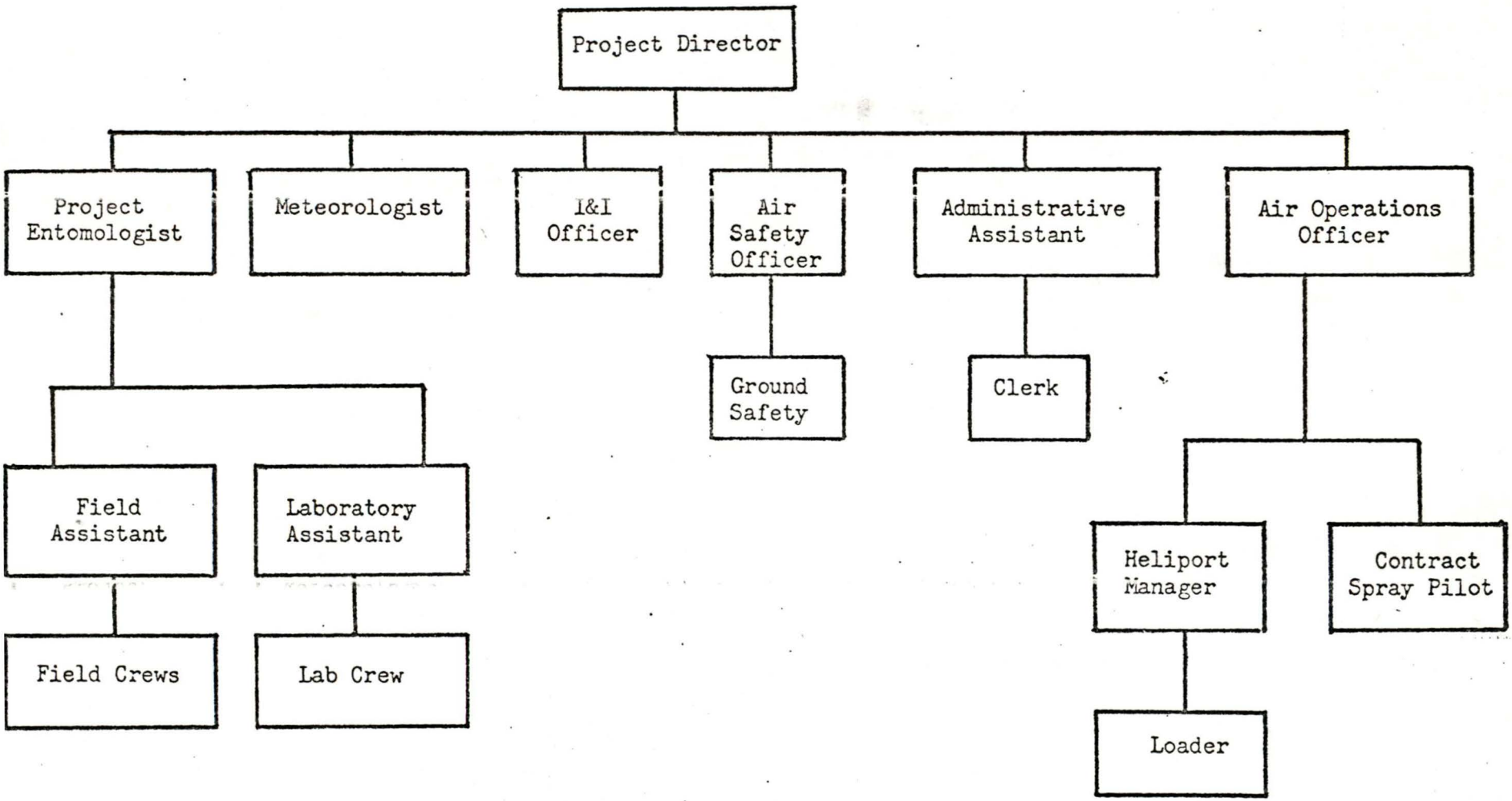
4. An estimate of the cost per acre for operational application.

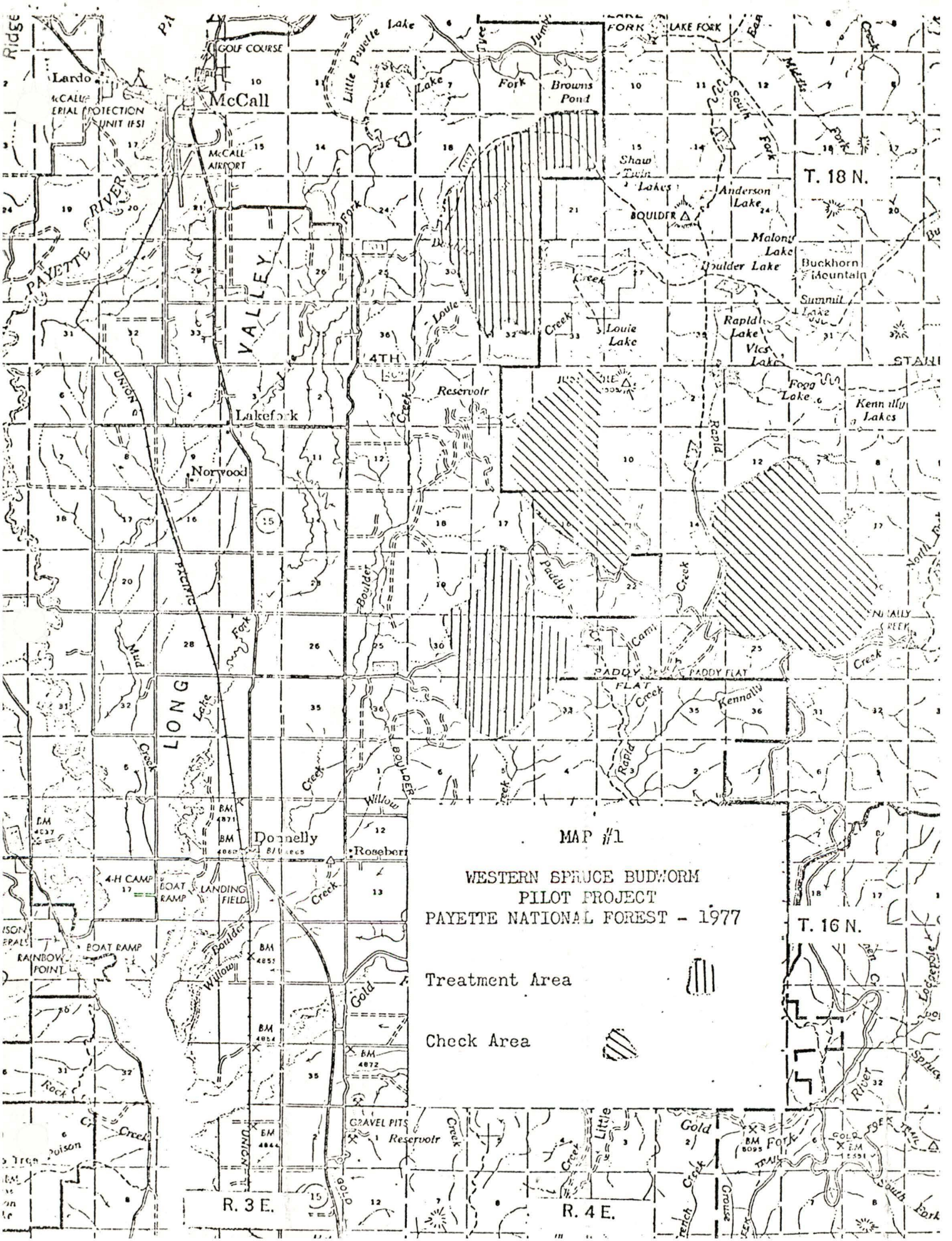
5. An expenditure summary for the completed pilot project.

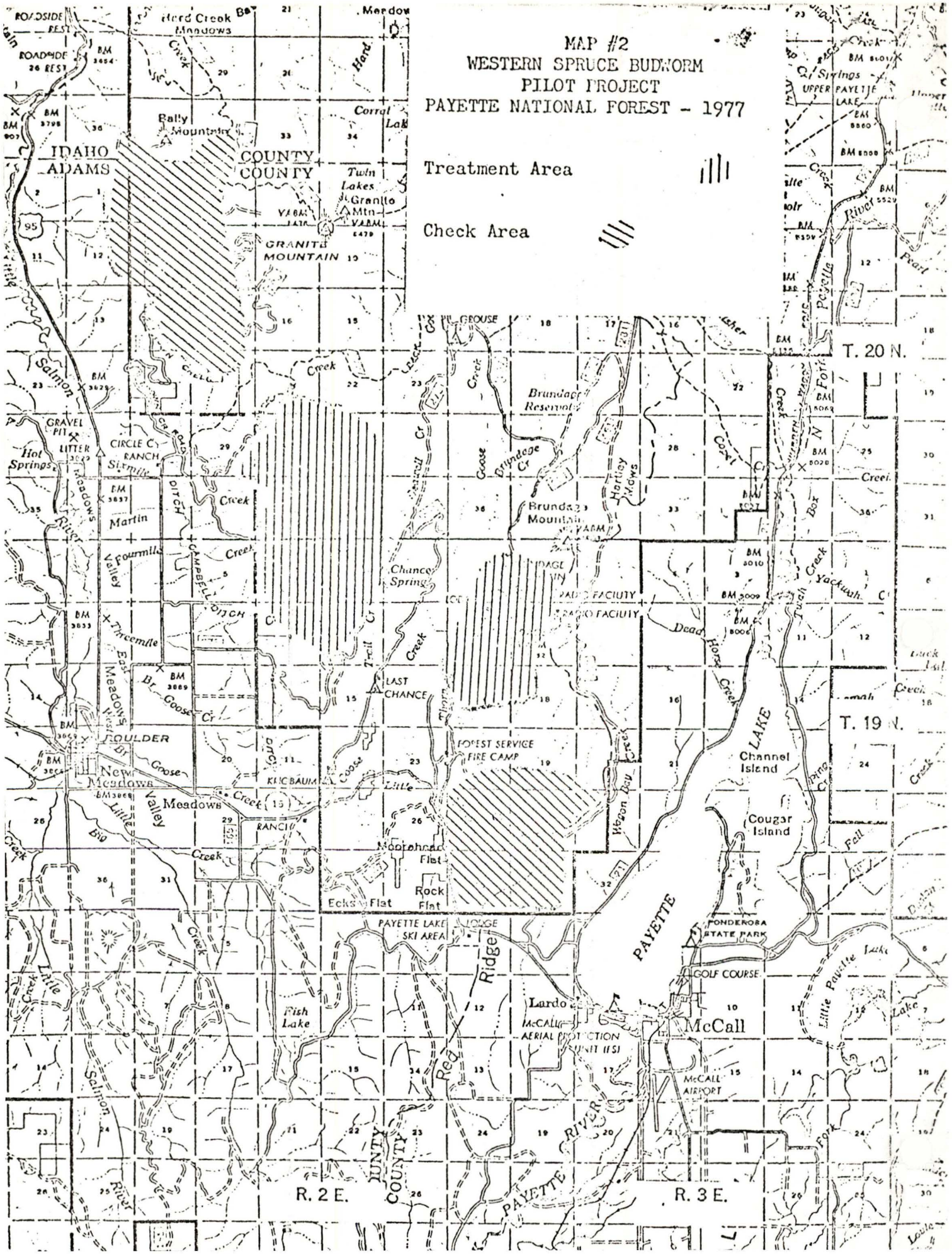
6. A discussion concerning ways in which the Pilot Project chemical testing procedure might be improved.

The persons responsible for the timely completion of this report will include the Director of Insect and Disease Management, The Project Director, The Project Entomologist and the Project Air Operations Officer.

Figure 1. Orthene® Pilot Test organizational chart.




MAP #1
WESTERN SPRUCE BUDWORM
PILOT PROJECT
PAYETTE NATIONAL FOREST - 1977
Treatment Area
Check Area
McCall
Donnelly
Lakefork
Norwood
Boulder
Lake Fork
Browns Pond
Shaw Twin Lakes
Anderson Lake
Boulder Lake
Malony Lake
Buckhorn Mountain
Summit Lake
Rapid Lake
Vics Lake
Louie Lake
Fogg Lake
Kennally Lakes
Paddy Flat
Reservoir
Gravel Pits
T. 18 N.
T. 16 N.
R. 3 E.
R. 4 E.
PAYETTE RIVER
LONG VALLEY
4TH
Golf Course
McCall Airport
4-H Camp
Boat Ramp
Landing Field
Rainbow Point


MAP #2
WESTERN SPRUCE BUDWORM
PILOT PROJECT
PAYETTE NATIONAL FOREST - 1977
Treatment Area
Check Area
IDAHO
ADAMS
COUNTY
COUNTY
GRANITE
MOUNTAIN
Granite
Mtn.
Twin
Lakes
Bally
Mountain
Corral
Lake
Hard
Creek
Meadows
Salmon
River
Hot
Springs
GRAVEL
PIT
LITTER
CIRCLE CY
RANCH
Martin
Fourmile
Valley
Thorncliffe
East
Meadows
Creek
CAMPBELL
DITCH
Chance
Spring
Trail
Creek
LAST
CHANCE
BOULDER
New
Meadows
KRIGBAUM
RANCH
Meadows
Valley
Little
Big
Creek
Goose
Creek
Brundage
Reservoir
Brundage
Mountain
Hartley
Meadows
Box
Canal
Creek
Yackuah
Creek
Dead
Horse
Creek
FOREST SERVICE
FIRE CAMP
Eckson Flat
Mooreshead
Flat
Rock
Flat
PAYETTE LAKE
SKI AREA
LODGE
Ridge
Red
Fish
Lake
Lardo
McCALL
AERIAL PROTECTION
UNIT (FS)
McCall
McCALL
AIRPORT
LAKE
Channel
Island
Cougar
Island
Wagon Bay
PONDEROSA
STATE PARK
GOLF COURSE
PAYETTE
Little Payette Lake
Payette
River
Fork
COUNTY
R. 2 E.
R. 3 E.
T. 20 N.
T. 19 N.